UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

July 24, 2014

Mr. Lou Chiarella
Assistant Regional Administrator for Habitat Conservation
Greater Atlantic Regional Fisheries Office
55 Great Republic Drive
Gloucester, MA 01930-2276

SUBJECT: ESSENTIAL FISH HABITAT ASSESSMENT FOR LICENSE RENEWAL OF THE LIMERICK GENERATING STATION, UNITS 1 AND 2

Dear Mr. Chiarella:

In a letter dated May 30, 2012, the U.S. Nuclear Regulatory Commission (NRC) requested that the National Marine Fisheries Service (NMFS) provide any applicable information on Federally-listed, proposed, and candidate species and critical habitat that may be in the vicinity of Limerick Generating Station, Units 1 and 2 (LGS). The NMFS replied to this request on June 27, 2012, and indicated that neither the Schuylkill River nor Perkiomen Creek are designated as Essential Fish Habitat (EFH) (NMFS 2012). NMFS stated, however, that although the Schuylkill River and Perkiomen Creek are not currently designated as EFH, these waterways provide habitat for anadromous prey species used by bluefish, windowpane, winter skate, and summer flounder, which are all Federally-managed species whose EFH has been designated in the mixing zone of the Delaware River. NMFS concluded that actions that reduce the availability of a major prey species, either through direct harm or capture, or through adverse impacts to the prey species' habitat, may be considered adverse effects on EFH.

The enclosed EFH Assessment provides an evaluation of the potential impacts on designated EFH during the period of continued operation for LGS through the proposed 20-year relicensing period (Enclosure 1).

The NRC staff considered a total of 10 species with designated EFH in the mixing zone of the Delaware River. Of these 10 species, the NRC staff has determined that license renewal for LGS will have **no adverse effect** on EFH for 6 of the 10 species. Of the remaining four species, the NRC staff determined that the proposed license renewal of LGS would have a **minimal adverse effect** on EFH for juvenile and adult bluefish (*Pomatomus saltatrix)*, juvenile and adult summer flounder (*Paralicthys dentatus*), juvenile and adult windowpane flounder *(Scopthalmus aquosus)*, and juvenile and adult winter skate (*Leucoraja ocellata*). In reaching our conclusion, the NRC staff relied on information provided by the applicant, on research performed by NRC staff, and on information from the NMFS.

Per the NRC staff's EFH Assessment determinations, we are requesting abbreviated consultation and that you review the enclosed EFH Assessment and provide your EFH Conservation Recommendations to us within 30 days. If you have any questions or require additional information, please contact Ms. Michelle Moser, Aquatic Biologist, by phone at 301-415-6509 or by e-mail at Michelle.Moser@nrc.gov or Ms. Leslie Perkins, Environmental Project Manager, by phone at 301-415-2375 or by e-mail at Leslie.Perkins@nrc.gov.

Sincerely,

/RA/

David J. Wrona, Chief
Environmental Review and
Guidance Update Branch
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket Nos. 50-352 and 50-353

Enclosures:
As stated

cc w/encls: Listserv

References:

[NMFS] National Marine Fisheries Service. 2004. Essential Fish Habitat Consultation Guidance, Version 1.1. April 2004. Silver Spring, MD.

[NMFS] National Marine Fisheries Service. 2012. Letter from Mary A. Colligan, Assistant Regional Administrator for Protected Resources, NMFS, to J. Susco, Acting Branch Chief, NRC. June 2, 2012. ADAMS No. ML12226A163

[NRC] U.S. Nuclear Regulatory Commission. 2012. Letter from J. Susco, RERB Acting Branch Chief, NRC, to D. Morris, Acting Regional Administrator, National Marine Fisheries Service. Subject: Request for list of Federal protected species within the area under evaluation for the Limerick Generating Station, Units 1 and 2, license renewal application review. May 30, 2012. ADAMS No. ML12138A347.

and adult summer flounder (*Paralicthys dentatus*), juvenile and adult windowpane flounder *(Scopthalmus aquosus)*, and juvenile and adult winter skate (*Leucoraja ocellata*). In reaching our conclusion, the NRC staff relied on information provided by the applicant, on research performed by NRC staff, and on information from the NMFS.

Per the NRC staff's EFH Assessment determinations, we are requesting abbreviated consultation and that you review the enclosed EFH Assessment and provide your EFH Conservation Recommendations to us within 30 days. If you have any questions or require additional information, please contact Ms. Michelle Moser, Aquatic Biologist, by phone at 301-415-6509 or by e-mail at Michelle.Moser@nrc.gov or Ms. Leslie Perkins, Environmental Project Manager, by phone at 301-415-2375 or by e-mail at Leslie.Perkins@nrc.gov.

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ADAM Accession No.: ML14195A346 *concurred via email

OFFICE	LA:DLR	PM:DLR:RPB2	AQ:DLR:RERB	BC:DLR:RPB2
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Letter to L. Chiarella from D. Wrona dated July 24, 2014

SUBJECT: ESSENTIAL FISH HABITAT ASSESSMENT FOR LICENSE RENEWAL OF THE LIMERICK GENERATING STATION, UNITS 1 AND 2

DISTRIBUTION:

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Essential Fish Habitat Assessment

Limerick Generating Station, Units 1 and 2
Proposed License Renewal

July 2014

Docket Numbers 50-352, 50-353

U.S. Nuclear Regulatory Commission
Rockville, Maryland

Prepared by:

Michelle Moser
Division of License Renewal
Office of Nuclear Reactor Regulation

ENCLOSURE

Table of Contents

Abbreviations, Acronyms, and Symbols

ac	Acre(s)
ADAMS	Agencywide Documents Access and Management System
CFR	*U.S. Code of Federal Regulations*
cfs	cubic feet per second
cm	Centimeter
DRBC	Delaware River Basin Commission
EFH	Essential Fish Habitat
fps	feet per second
FR	Federal Register
ft	Foot
GEIS	generic environmental impact statement
gpm	gallons per minute
ha	Hectare
in.	Inch
km	Kilometer
LGS	Limerick Generating Station, Units 1 and 2
m	Meter
m/s	meters per second
m^3/s	cubic meters per second
m^3/d	cubic meters per day
mgd	million gallons per day
mi	Mile
MSA	Magnuson-Stevens Fishery and Conservation Management Act
NAI	Normandeau Associates, Inc.
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NMFS	National Marine Fisheries Service
NRC	U.S. Nuclear Regulatory Commission
PDEP	Pennsylvania Department of Environmental Protection
PFBC	Pennsylvania Fish and Boat Commission
RMC	RMC Environmental Services
URS	URS Corporation
USGCRP	U.S. Global Change Research Program
USGS	U.S. Geological Survey

1.0 Introduction

In compliance with Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), the U.S. Nuclear Regulatory Commission (NRC) prepared this Essential Fish Habitat (EFH) Assessment for the proposed Federal action: NRC's decision whether or not to renew the operating licenses for Limerick Generating Station, Units 1 and 2 (LGS). LGS is located in Limerick Township of Montgomery County, Pennsylvania along the Schuylkill River.

In a June 27, 2012, letter to the NRC pursuant to the MSA, the National Marine Fisheries Service (NMFS) (2012) indicated that the Schuylkill River and Perkiomen Creek are not currently designated as EFH for any species. However, these waterways provide habitat for a variety of prey species used by bluefish (*Pomatomus saltatrix)*, windowpane flounder (*Scophthalmus aquosus*), winter skate (*Leucoraja ocellata*), and summer flounder (*Paralicthys dentatus*), which are all Federally managed species whose EFH has been designated in the mixing zone of the Delaware River. The mixing zone of a river is the portion of the river in which freshwater from the river mixes with salt water from an estuary or ocean. In the Delaware River, NMFS (1985) defines the mixing zone as the area from the upper portion of the Delaware Bay with a salinity up to 0.5 parts per thousand through the lower portions of the Delaware River with a salinity up to 25 parts per thousand). The mixing zone reaches as far as 96 river miles up the Delaware River (NMFS 1985, DRBC 2014). Anadromous fish in the mixing zone of the Delaware River that would migrate as far as the LGS cooling system include American shad (*Alosa sapidissima*) and river herring (alewife, *A. pseudoharengus* or blueback herring, *A. aestivalis*) (NMFS 2012). Anadromous fish require movement between freshwater and marine marine waters to spawn in freshwater and inhabit marine waters as adults (Perillo and Butler 2009).

The EFH final rule published in Volume 67 of the Federal Register, page 2343, on January 17, 2002, defines an adverse effect as "any impact which reduces the quality and/or quantity of EFH," which may include the loss of, or injury to, EFH prey species and their habitat.

Accordingly, this EFH Assessment does the following:

- Describes the proposed action.
- Identifies relevant species with designated EFH within the mixing zone of the Delaware River and that consume the young of anadromous species that migrate upriver and into tributaries near the LGS cooling system.
- Assesses if the proposed action may adversely affect any designated EFH.
- Describes potential measures to avoid, minimize, or offset potential adverse impacts to EFH as a result of the proposed action.

2.0 Description of the Proposed Action

The proposed Federal action is the NRC's decision whether to issue renewed licenses authorizing LGS to operate for an additional 20 years beyond the expiration of the initial operating licenses.

Exelon Generation Company, LLC (Exelon), initiated the proposed Federal action by submitting an application for the license renewal of LGS for which the existing licenses—NPF-39 (Unit 1) and NPF-85 (Unit 2)—will remain in effect until October 26, 2024, and June 22, 2029, respectively, or until the issuance of renewed licenses. If the NRC issues renewed licenses for LGS, Exelon could continue to operate through October 26, 2044 (Unit 1), and June 22, 2049 (Unit 2). If the operating licenses are denied, the facility must be shut down on or before the expiration dates of the current operating licenses.

Under the NRC's environmental protection regulations at Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," which implement the National Environmental Policy Act of 1969, the NRC published a draft supplemental environmental impact statement (SEIS) for LGS (NRC 2013a) in April 2013. The SEIS is a site-specific supplement to NUREG-1437, "*Generic Environmental Impact Statement [GEIS] for License Renewal of Nuclear Plants*," (NRC 1996, 2013b).

License renewal would involve continued maintenance and operation activities within developed or previously disturbed areas of the LGS site, and continued operation and maintenance of the Perkiomen Pumphouse, Bradshaw Reservoir and Pumphouse, and the Bedminster Water Processing Facility. Exelon (2011) did not identify the need to undertake any major construction, refurbishment, or replacement actions associated with license renewal to support the continued operation of LGS beyond the end of the existing operating licenses.

2.1 Site Location and Description

LGS is located in Limerick Township of Montgomery County, Pennsylvania, 1.7 miles (mi) (2.7 kilometers [km]) southeast of the Borough of Pottstown (Exelon 2011). The City of Reading is about 19 mi (30.6 km) northwest of the site and the Borough of Phoenixville is about 9.3 mi (15 km) southeast of the site. Other nearby population centers are the Municipality of Norristown, which is about 11 mi (17.7 km) southeast of the site, and the City of Philadelphia, the city limits of which are about 21 mi (33.8 km) southeast from the site. Figure 1 and Figure 2 present the 6-mi (10-km) and 50-mi (80-km) vicinity maps, respectively.

LGS is a two-unit nuclear-powered steam electric generating facility that began commercial operation in February 1986 (Unit 1) and January 1990 (Unit 2). The nuclear reactor for each unit is a General Electric boiling water reactor producing a reactor core rated thermal power of 3,515 megawatts. The nominal net electrical capacity is 1,170 megawatts electric. Figure 3 provides a general site layout of LGS. Both LGS reactors have Mark II primary containment structures.

The LGS plant site comprises a total of 645 acres (ac) (261 hectares [ha]), including 491 ac (199 ha) in Montgomery County and 154 ac (62.3 ha) in Chester County. The LGS site is located along the Schuylkill River, which flows in a southeasterly direction approximately 48 river miles to its confluence with the Delaware River. The Schuylkill River passes through the LGS plant site and separates its western portion, which is located in Chester County, from its eastern portion, which is located in Montgomery County.

The site is surrounded by gently rolling countryside and farmland, with several valleys containing tributary drainages of the Schuylkill River. The vicinity of the site has experienced suburban growth due to the conversion of local farmland to several new residential subdivisions since the LGS units started operations in 1986 and 1990.

Exelon owns both the primary LGS site and several offsite support facilities, including the Perkiomen Pumphouse, the Perkiomen Pumphouse-to-LGS pipeline, Bradshaw Reservoir and Pumphouse, and the Bedminster Water Processing (Treatment) Facility. All activities on the

LGS site are under the control of Exelon. The following additional offsite facilities and components of the LGS makeup water system have contractual agreements with Exelon; however, Exelon does not own or control them:

- Wadesville Mine Pool, Pumphouse, and discharge channel
- Still Creek Reservoir
- Point Pleasant Pumping Station and combined water transmission main to the Bradshaw Reservoir
- Pottstown Gage Station, the Graterford Gage Station, and the Bucks Road Gage Station

Exelon jointly owns and operates the Merrill Creek Reservoir near Phillipsburg, New Jersey, with six other utilities. The reservoir stores water for release when required to mitigate consumptive use at designated electric generating facilities, including LGS, in the event of low-flow conditions in the Delaware River (Section 2.2).

2.2 Cooling and Auxiliary Water Systems

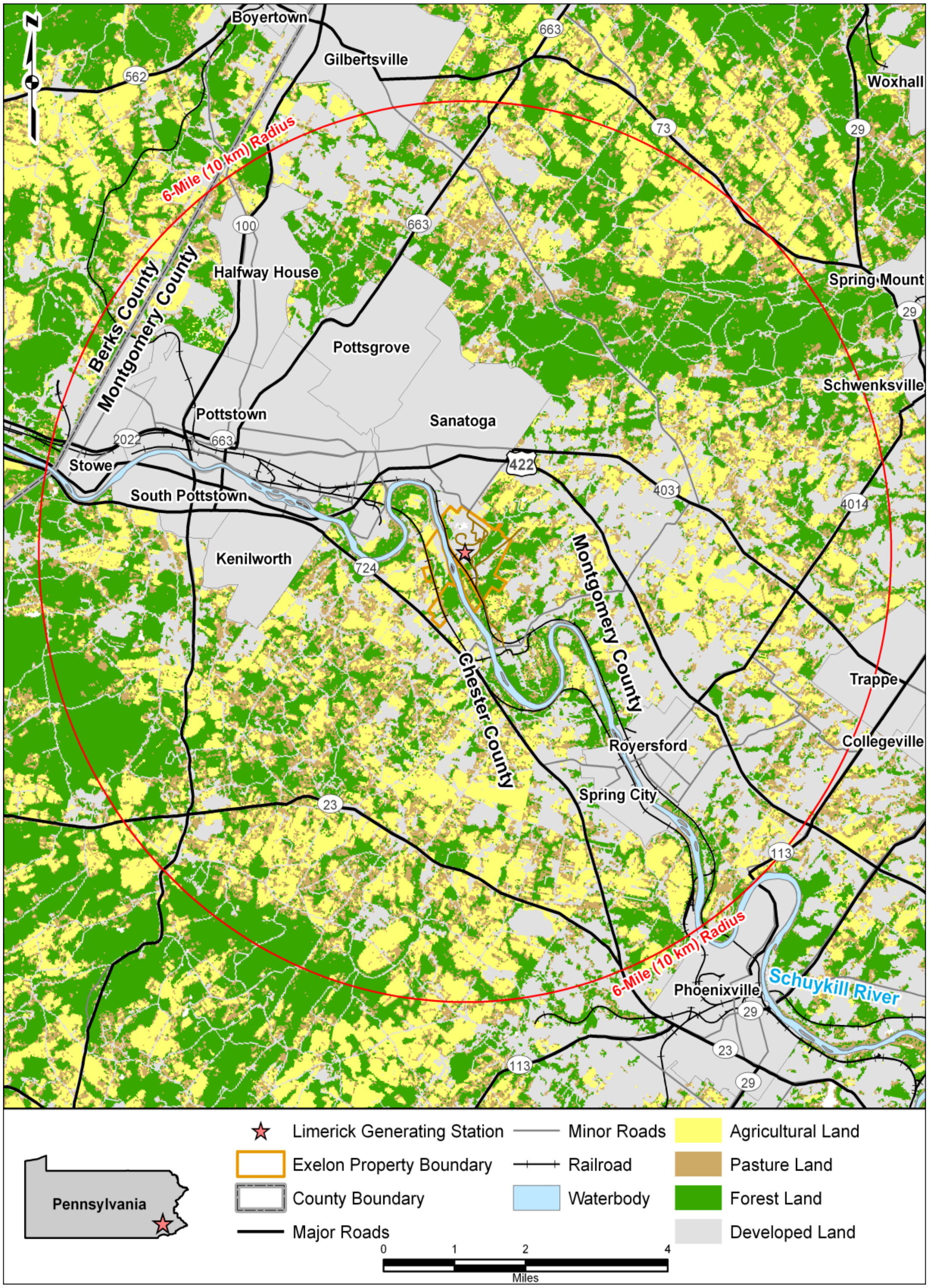
LGS uses a cooling tower-based heat dissipation system that normally withdraws from and discharges cooling water to the Schuylkill River. The majority of the makeup water withdrawn from the Schuylkill River provides cooling water for the LGS steam turbine condensers. As water evaporates in the cooling towers to dissipate heat to the atmosphere, cooling water is lost and must be replaced. Additionally, to control the chemistry of the circulating water in the cooling system, a portion of the cooling water is continuously discharged (i.e., blowdown). A much smaller portion of the makeup water is used to remove heat from auxiliary equipment during normal operation. A clay-lined spray pond located north of the cooling towers provides emergency cooling but has an insignificant interface with the environment. Four groundwater wells are also located on the LGS site to support LGS operations. Unless otherwise cited for clarity, the NRC drew information about LGS's cooling and auxiliary water systems from Exelon's ER (Exelon 2011) and responses to NRC's request for additional information (Exelon 2012a). The NRC staff also toured these systems and facilities during the environmental site audit (NRC 2012).

Individual LGS systems that affect the aquatic environment are summarized below and focus on facilities owned and operated by Exelon.

<u>Makeup Water Supply System</u>

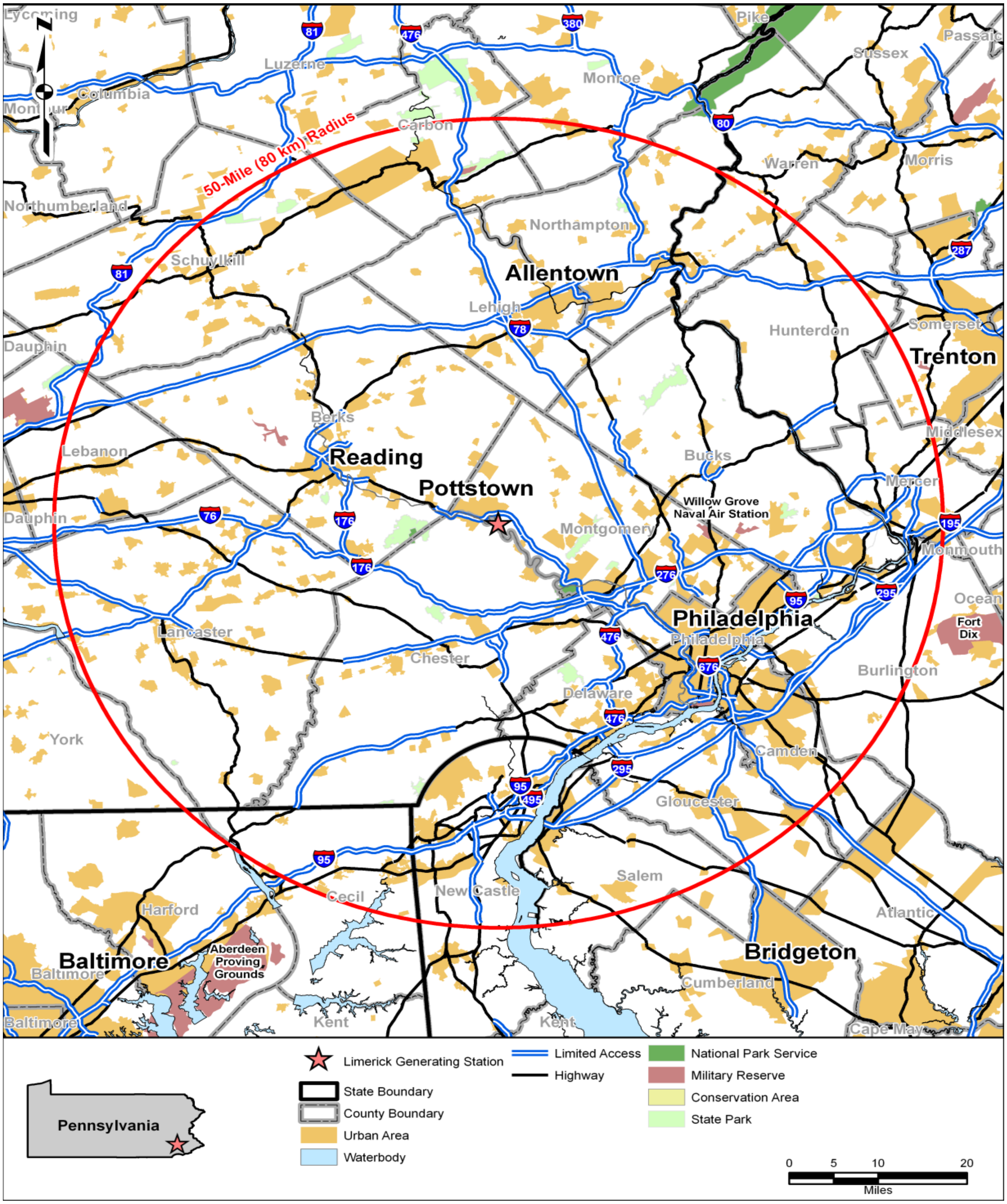
The LGS makeup water supply system comprises the individual water sources, facilities, systems, and components used for supplying makeup water to LGS plant systems. These systems include the cooling water system, including the circulating water systems for each LGS unit, and other plant systems. The demand for makeup water for LGS nominally totals 56.2 million gallons per day (mgd) or 39,000 gallons per minute (gpm) (87 cubic feet per second [cfs] or 2.5 cubic meters per second [m^3/s]). For full operations, this demand includes 42 mgd or 29,200 gpm (65 cfs or 1.8 m^3/s) for consumptive cooling water use and 14.2 mgd or 9,860 gpm (22 cfs or 0.6 m^3/s) for non-consumptive use (Exelon 2011). LGS primarily relies on the Schuylkill River for its makeup water supply and, secondarily, the Perkiomen Creek. In addition, Exelon has developed an extensive surface water diversion system to manage (augment) low river flows on the Schuylkill River and the Perkiomen Creek. The information below discusses these makeup sources and associated facilities and their attributes.

Figure 1. Location of LGS, 6-Mi (10-Km) Vicinity



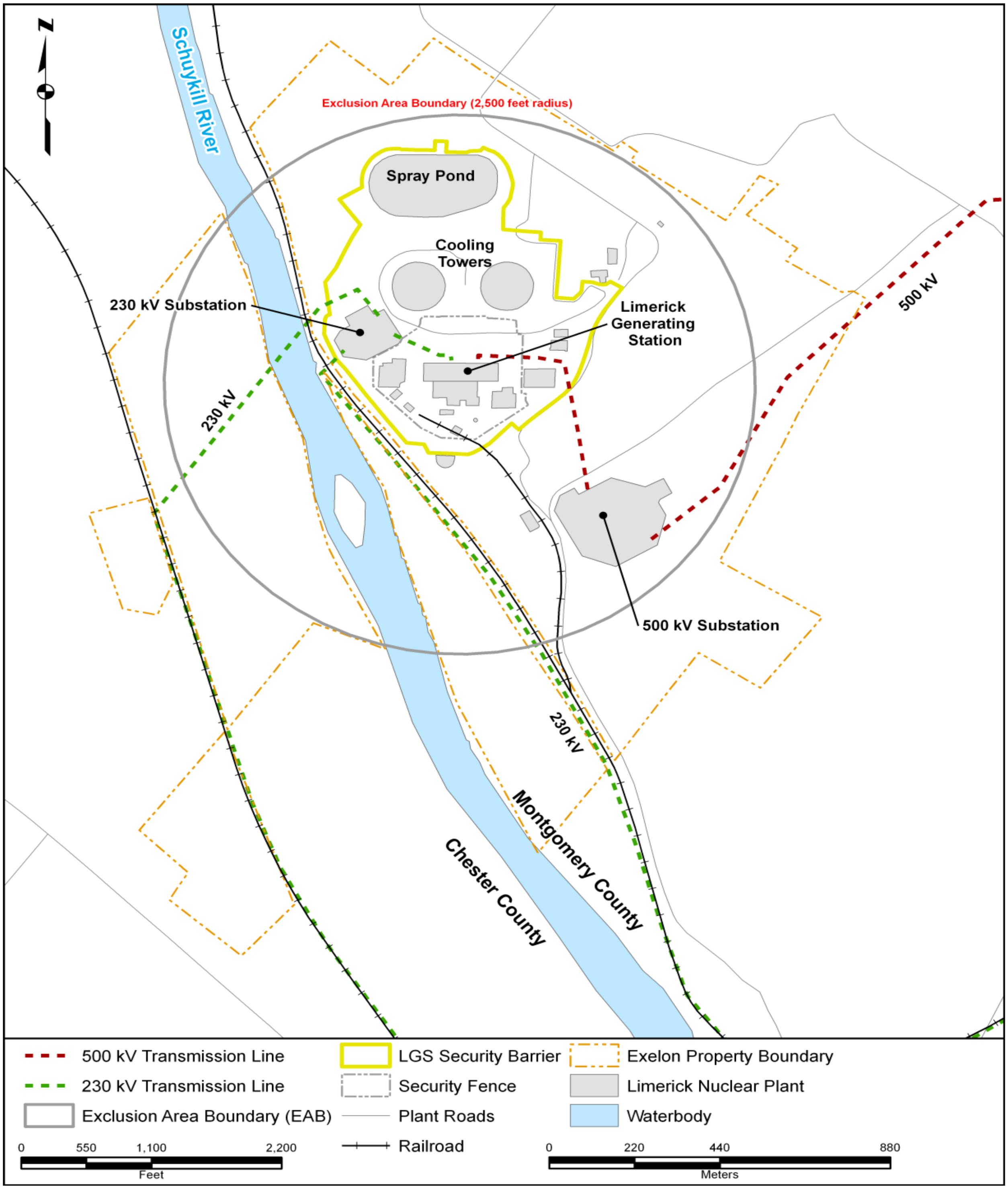
Source: Exelon 2011

Figure 2. Location of LGS, 50-Mi (80-Km) Region



Source: Exelon 2011

Figure 3. LGS Site Boundary and Facility Layout



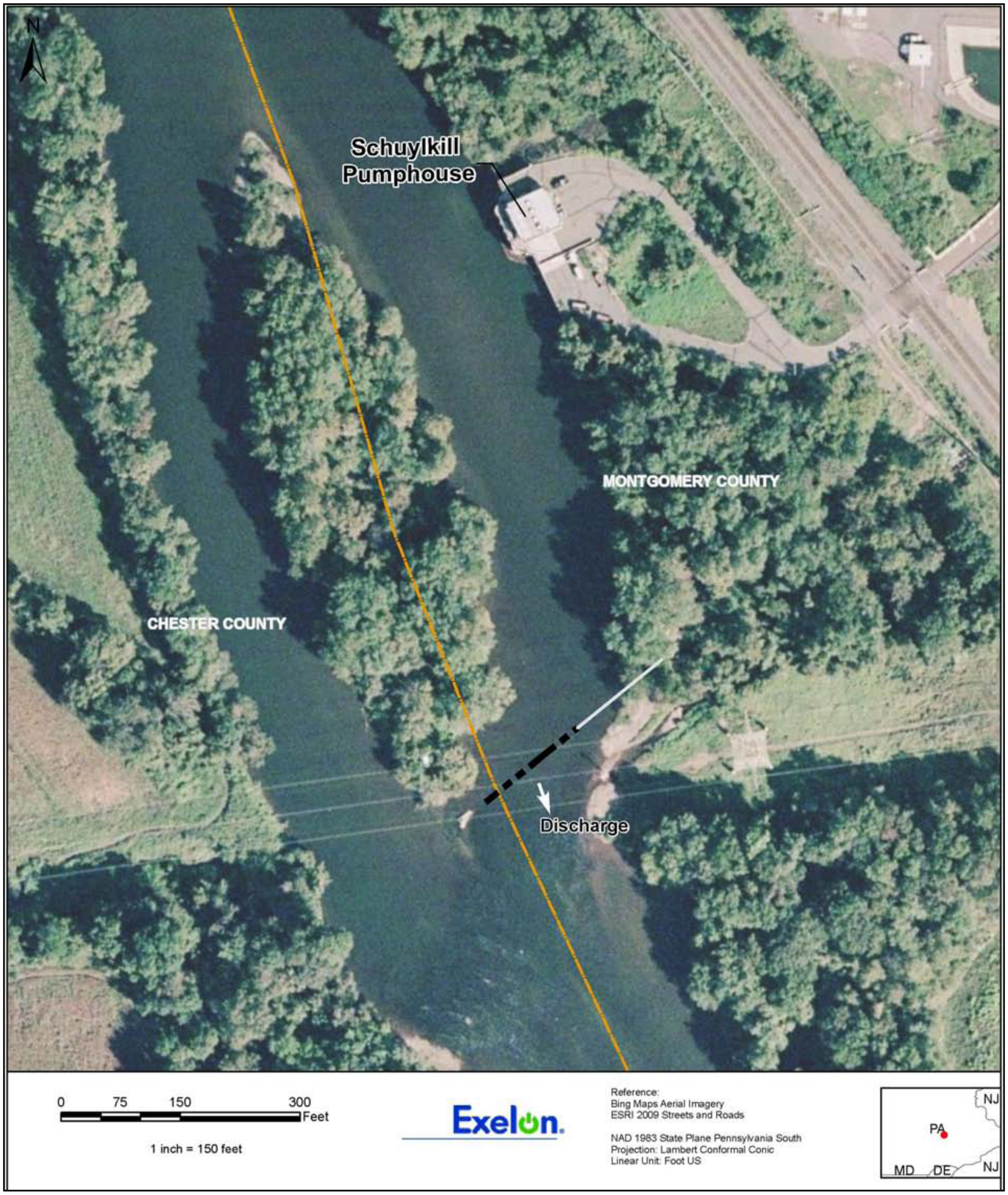
Source: Exelon 2011

Schuylkill River Source

The Schuylkill River is the primary source of makeup water for LGS (Figure 4). Water is withdrawn from the river through the Schuylkill Pumphouse located on the eastern bank of the river on the LGS site. River water enters the pumphouse through eight trash rack (bar screen) panels with 8.9-cm (3.5-inch) vertical bar spacing. A floating trash dock with a skirt, which is located in front of the trash rack, diverts river debris and some aquatic life before they can reach the trash racks. Intake water then passes through four traveling screens before entering the intake bays (Exelon 2012a). The screens have 0.25-inch (in.) (0.64-cenimeter [cm]) mesh openings and water approaches the screens at a velocity of 0.61 foot per second (fps) (0.19 meter per second [m/s]) (Exelon 2012a, Exelon 2013, DRBC 2013a). An automatic backwash system cleans the traveling screens of debris to maintain adequate pump wet-well levels. Screen backwash water returns to the river through an outfall permitted through the Pennsylvania National Pollutant Discharge Elimination System (NPDES) Permit Program (NPDES Permit No. 011). Leaves and debris removed from the traveling screens are collected in a dumpster and transported off site for disposal (Exelon 2012a). The facility has three pumps for cooling water makeup and two pumps for blowdown (nonconsumptive) water makeup. The three cooling water pumps each have a rated capacity of 11,300 gpm (25.2 cfs or 0.71 m^3/s), and the two blowdown makeup pumps are each rated at 4,000 gpm (8.9 cfs or 0.25 m^3/s). These pumps are usable in any combination to meet the total plant makeup demand (for consumptive and nonconsumptive use) of up to 56.2 mgd (212,700 cubic meters per day [m^3/d]). From the pumphouse, a 36-in. (91-cm) pipeline conveys water to the cooling tower basins. Two smaller lines supply water to a raw water clarifier in the process water treatment system and the spray pond.

LGS operates its makeup water supply system and uses its makeup sources in accordance with Delaware River Basin Commission (DRBC) approvals. Seasonal low flows in the Schuylkill River and specific conditions and limitations imposed by the DRBC require LGS to use alternative makeup water sources to augment flow in the Schuylkill River. Source augmentation averaging 35 mgd (132,500 m^3/d) or 24,300 gpm (54.1 cfs or 1.5 m^3/s) is required about 6 months per year (Exelon 2012b). Under DRBC rules and regulations, dockets are used to place limits and conditions on individual projects, such as LGS, that use water within the Delaware River Basin. DRBC Docket No. D-1969-210 CP-13 was finalized in May 2013 (Section 2.2.1) to consolidate, in part, 12 previous dockets and multiple DRBC resolutions approved with respect to LGS operations since 1973 (DRBC 2013b). It prescribes the low-flow conditions that trigger the requirement for LGS to use alternative water sources for consumptive use, while also providing for terms and conditions with respect to non-contact cooling water and cooling tower blowdown discharges from LGS (DRBC 2013a, 2013c). Specifically, the DRBC docket restricts surface water withdrawals from the Schuylkill River for consumptive use to protect water quality and quantity (Docket No. D-1969-210 CP-13, as revised) (DRBC 2013a, 2013c). These restrictions are triggered, requiring Exelon to augment water flows in the Schuylkill or switch to alternative water sources, when either the flow of the river falls below 560 cfs (15.9 m^3/s) for two-unit operation, or 530 cfs (15 m^3/s) for one-unit operation. This is adjusted based on upstream releases from DRBC-approved projects (DRBC 2004, 2013a; Exelon 2011).

Figure 4. Location of Schuylkill Pumphouse and LGS Discharge Structure



Source: Exelon 2011

When the triggering of restrictions prevents Exelon from withdrawing water from the Schuylkill River, a combination of the DRBC-approved alternative water sources (as depicted in Figure 5) are used to supply consumptive use makeup water to LGS, although LGS may withdraw water from the Schuylkill River for nonconsumptive use without restriction. The sections below describe potential augmentation sources for the Schuylkill River (e.g., Wadesville Mine Pool and Still Creek Reservoir) and alternative sources of water for withdrawal (e.g., Perkiomen Creek).

Wadesville Mine Pool and Still Creek Reservoir Augmentation Sources for Schuylkill River

LGS uses two upstream water sources, the Wadesville Mine Pool and Still Creek Reservoir, to directly augment Schuylkill River flow (Figure 5). The Wadesville Mine Pool is located approximately 70 mi (112 km) northwest of LGS in Pennsylvania's anthracite coal region. The mine pool is comprised of an extensive complex of flooded underground mine workings some 700 ft (210 m) deep, storing an estimated 3.6 billion gal (13.6 billion m^3) of water. The mine pool is unique, as compared to other coal workings that contribute to acid mine drainage, in that the water percolating through the workings has a neutral pH (NAI and URS 2011). Additionally, releases from the Still Creek Reservoir, located northeast of the Wadesville Mine Pool, are included in the list of approved supplemental water sources under the consolidated docket governing LGS's operations (DRBC 2013a, 2013c). DRBC previously approved this reservoir for emergency releases under a contract between Exelon and its owner and operator to augment low flows in the Schuylkill River when the Delaware River diversion system is unavailable (Section 2.2.1).

Perkiomen Creek Source

LGS may withdraw water from Perkiomen Creek when the flow in the Schuylkill River begins to drop below 560 cfs (15.9 m^3/s) for two-unit operation (as measured at the Pottstown, PA, gauge station, which is maintained by the U.S. Geological Survey [USGS]) if in-stream flow conditions in Perkiomen Creek allow. Water is withdrawn via Exelon's Perkiomen Pumphouse (auxiliary intake pumphouse), which is located just inland from the west bank of Perkiomen Creek. Water is withdrawn from the creek through a set of 15 submerged, stationary "wedge-wire" screen intakes on the middle of the streambed. The size of each screen is 24-in. (61-cm) by 72-in. (183-cm), with a slot size of 0.08 in. (0.2 cm). The screens provide an average through-slot velocity of 0.4 fps (0.12 m/s). An air burst backwash system automatically functions to remove accumulated debris (Exelon 2012a). Three intake pumps, including a spare, rated at 14,600 gpm (33 cfs or 0.92 m^3/s) are sized to supply the consumptive cooling demands for both LGS units. A small auxiliary pump operates as needed to maintain the facility's water storage tank when the intake system is not active. An underground pipeline conveys water approximately 8 mi (13 km) to the storage tank located at the LGS site.

Delaware River Augmentation Source for the Perkiomen Creek

The natural flow in Perkiomen Creek is not always adequate for LGS's consumptive makeup water needs. This situation arises when the natural flow of Perkiomen Creek falls below 210 cfs (5.9 m^3/s) for two-unit operation, as measured at the USGS-maintained Graterford, Pennsylvania, gage station. Therefore, Exelon has established a system to transfer water for flow augmentation purposes from the Delaware River to East Branch Perkiomen Creek and, ultimately, Perkiomen Creek. This diversion of water originates at the Point Pleasant Pumping Station on the Delaware River, located about 30 mi (48 km) northeast of the LGS site, near river mile 154 (Figure 5). A municipal water purveyor, not Exelon, owns the pumping station. The Point Pleasant Pumping Station withdraws from a deep-water midchannel intake in the Delaware River. The intake structure consists of two rows of fixed cylindrical wedge-wire screens. Each row comprises 12 screens, each of which measures 40-in. (102 cm) in diameter with 80-in. (203 cm) of total screened length and has a slot size of 0.08 in. (0.2 cm). At the maximum pumping rate of 95 mgd (360,000 m^3/d), the average intake velocity is 0.35 fps (0.11 m/s). Maintenance of the intake screens includes high-pressure spray washing and scrubbing by divers four times a year, with return of organic debris to the Delaware River (Exelon 2012a).

Once withdrawn at Point Pleasant, water is conveyed through a series of pumping stations to the Bradshaw Reservoir and then through transmission mains to East Branch Perkiomen Creek. At the outset, water is transferred as necessary to the Bradshaw Reservoir to maintain adequate reservoir operational volume and reserve storage. The Exelon-owned and -operated reservoir and associated Bradshaw Pumphouse are located on a 43-ac (17-ha) site and are approximately 27 miles (44 km) northwest of LGS. The reservoir is maintained at an operating level of 17 to 21 ft (5.2 to 6.4 m), and the reservoir can be pumped down as far as 8 ft (2.4 m) before suction is lost. From the Bradshaw Reservoir, water is pumped about 6 miles (10 km) by pipeline routed along a natural gas pipeline right-of-way to East Branch Perkiomen Creek. The Bedminster Water Processing (Treatment) Facility, which Exelon also owns and operates, is located about midway along the pipeline routing. This facility seasonally disinfects the water before it is discharged into the East Branch Perkiomen Creek in accordance with NPDES Permit No. PA0052221.

In the event that drought conditions on the Delaware River threaten the ability to transfer water to East Branch Perkiomen Creek, Exelon also has an agreement in place as one of the seven utility owners of the Merrill Creek Reservoir in northwestern New Jersey to release water to the Delaware River for flow augmentation purposes. This agreement could be exercised in the event of a DRBC-declared drought emergency. A separate DRBC docket governs operation of the reservoir.

Circulating Water System

The LGS circulating water system is a closed-cycle cooling system that removes heat from the condenser and transfers it to the atmosphere through evaporation using hyperbolic natural-draft cooling towers. The plant's twin cooling towers rise more than 500 ft (152 m) above the ground. The circulating water system uses water from the LGS makeup water system to replenish the water lost from evaporation, drift, and blowdown. For each LGS unit, the circulating water system consists of one cooling tower, three main condensers, four 25-percent-capacity circulating water pumps, and associated piping, valves, controls, and instrumentation.

Blowdown Discharge System

Operation of LGS's closed-cycle cooling system results in evaporative water losses of approximately 75 percent from the plant's twin cooling towers. To control the chemistry of the water in the cooling system due to the buildup of total dissolved solids, a portion of the water must be continuously discharged. Each cooling tower basin has a blowdown line that combines into a single 36-in. (91.4-cm) line that discharges through a submerged multi-port diffuser pipe into the Schuylkill River at a point about 700 ft (210 m) downstream from the Schuylkill Pumphouse (Figure 4). The diffuser is encased in a concrete channel stabilization structure on the east side of the river. The discharge structure consists of a 28-in. (71-cm) pipe with a total of 283 nozzles installed on 6-in. (15-cm) centers; nozzles have a 1.25-in. (3.2-cm) diameter opening. As shown in Figure 4, the diffuser does not use the entire channel width. This is LGS's main outfall (no. 001), which is regulated under its Pennsylvania NPDES permit (No. PA0051926), in addition to DRBC docket provisions (Exelon 2011).

Figure 5. LGS Makeup Water Supply System and Alternative Water Sources within the Delaware River Basin

Source: Modified from Exelon 2011

Plant Service Water System

The plant service water system functions continuously to supply water for service-water cooling (e.g., removal of heat rejected from auxiliary equipment), emergency service water, residual heat removal service water, and the clarified water system. Generally, these are small and normally nonconsumptive uses of water.

Each LGS unit has a non-safety-related single-loop cooling system for normal operations that uses three 50-percent capacity pumps operating, with one pump on standby status. These loops take water from each unit's cooling tower basin. These pumps circulate cooling water from the cooling tower basins through various heat exchangers and then back to the cooling towers. This service water system may also support decay heat removal during a refueling outage.

An emergency service water system exists to supply cooling water to emergency equipment in the event of the loss of normal cooling. The system consists of two independent cooling loops and associated pumps. The pumps circulate water through the LGS spray pond located north of the LGS cooling towers for cooling through spray nozzles or winter bypass lines. Another safety-related system, the residual heat removal system, is also routed through the spray pond. The two loops of this system supply cooling water to each of the two heat exchangers that serve each LGS unit.

Clarified river water for component lubrication and as makeup to the demineralized water system is supplied by the clarified water system. This system uses water from the cooling water intake system.

Groundwater Supply System

Potable water and a backup supply of fire emergency water for LGS are provided by two separate wells. Two additional wells supply non-potable water intermittently to the Limerick Training Center and the Limerick Energy Information Center, respectively.

2.2.1 Delaware River Basin Commission Docket for LGS

LGS water usage is governed by the DRBC docket approval that restricts surface water withdrawals from the Schuylkill River for consumptive use to protect water quality and quantity. As previously described, these restrictions are triggered, requiring Exelon to switch to alternative water sources, when either the flow of the river falls below 560 cfs (15.9 m^3/s) for two-unit operation, or 530 cfs (15 m^3/s) for one-unit operation (DRBC 2004, 2013a; Exelon 2011).

In addition, the Pennsylvania Department of Environmental Protection (PDEP) requires water users to submit water use information annually, in support of its State Water Plan. Accordingly, Exelon reports LGS water usage to PDEP. The State Water Plan serves as a functional planning tool to establish vision, goals, and recommendations for meeting the challenges of sustainable water use over a 15-year planning horizon.

Since initiating the water supply diversion project in 2003, Exelon has sought to demonstrate that it could obtain makeup water demands from the Schuylkill River over a much wider range of conditions without deleterious effects. A major modification to this demonstration project that was approved in 2005 allowed, for the first time, withdrawals from the Schuylkill River for consumptive use when ambient water temperature was at or above 59 degrees Fahrenheit (F) (15 degrees Celsius [C]). Previously, DRBC prohibited withdrawals for consumptive use makeup water at or above that temperature and required LGS to rely on the Perkiomen Pumphouse (Exelon 2011). In summary, the objectives of the demonstration project included (1) gaining an understanding of increased reliance on the Schuylkill River, (2) evaluating the effects of permanently lifting the 59 degrees F (15 degrees C) temperature restriction, (3) evaluating the effects of using the Wadesville Mine Pool and Still Creek Reservoir as low flow augmentation sources, (4) evaluating the effects of reducing water diversions from the Delaware River, and (5) evaluating the effects on public water supplies (Exelon 2012b). Based on the results of the demonstration project, Exelon submitted an application to the DRBC in September 2007 to make the provisions of the demonstration project permanent to support LGS operations and to consolidate all DRBC docket approvals for surface water withdrawal, discharge, and groundwater usage into a single comprehensive docket (Exelon 2011, DRBC 2011a).

In May 2011, the DRBC passed a resolution approving Exelon's request to increase LGS's peak daily surface water withdrawals from 56.2 mgd or 39,000 gpm (87 cfs or 2.5 m^3/s) to 58.2 mgd or 40,420 gpm (90 cfs or 2.6 m^3/s). This request was made to increase consumptive use withdrawals by 2 mgd or 1,390 gpm (3.1 cfs or 0.09 m^3/s) to provide operational flexibility to counter conditions of high air temperature combined with low relative humidity that had caused LGS to approach its maximum daily withdrawal limit in 2010 (DRBC 2011b). In December 2011, the DRBC extended the terms of Docket No. D-69-210 CP Final (Revision 12) for LGS, including the demonstration project for another year to enable it to complete work on Exelon's consolidated revision and to hold a public hearing (DRBC 2011c).

Exelon officials met with DRBC officials on the status of the consolidated docket in February 2012 (Exelon 2012a). In June 2012, DRBC issued a draft consolidated docket (Revision 13) for review and comment and held a public hearing on August 28, 2012. The August 28, 2012, public hearing was held jointly with the PDEP to obtain comments on DRBC's draft consolidated docket and on PDEP's proposed NPDES permit revision for LGS. Subsequently, the DRBC voted once again to extend docket Revision 12 until December 31, 2013, or until the DRBC approved a revised docket. This action allowed additional time for the completion of a thorough comment and response document in consideration of comments received during the public hearing and associated 120-day comment period (DRBC 2012a).

On May 8, 2013, the DRBC voted unanimously to approve the consolidated docket, which provides terms and conditions for (1) withdrawing continued surface water from several sources to support LGS consumptive and nonconsumptive water uses, (2) permitting the discharge of noncontact cooling water and cooling tower blowdown to the Schuylkill River, and (3) approving the use of the supplemental water sources, including Wadesville Mine Pool, when LGS is restricted from withdrawing water from the Schuylkill River or the Perkiomen Creek. As evaluated during the demonstration project, the approved docket specifically rescinds the 59 degrees F (15 degrees C) temperature restriction on withdrawals from the Schuylkill River for consumptive cooling water needs. Finally, the docket also approves Exelon's water supply operation and maintenance plan which, in part, provides for the collection of data and analysis to determine Exelon's compliance with the terms of the docket (DRBC 2013a, 2013b, 2013c).

As of issuance of this EFH Assessment, the PDEP has not finalized revisions to LGS's NPDES Permit No. PA0051926; therefore, the terms and conditions of the current NPDES permit remain in effect until issuance of the revised permit.

Sections 2.1.1–2.1.5 of the LGS SEIS (NRC 2013a) provide additional information on the reactor and containment systems, other systems at LGS, and plant operations. Sections 2.1.7 and 2.2.5 of the LGS SEIS (NRC 2013a) provide additional information on LGS's surface water use and describe the NPDES permit.

3.0 Essential Fish Habitat Species Near the Site and Potential Adverse Impacts

3.1 Essential Fish Habitat Identified for Analysis

The waters and substrate necessary for spawning, breeding, feeding, or growth to maturity are considered EFH (16 U.S.C. 1802(10)). The Schuylkill River, Perkiomen Creek, and the portion of the Delaware River where Point Pleasant Pumping Station is located are not designated as EFH (NMFS 2012, NMFS 2014a). By letter dated June 27, 2012, NFMS stated, however, that although the Schuylkill River and Perkiomen Creek are not currently designated as EFH, these waterways provide habitat for anadromous prey species used by bluefish, windowpane flounder, winter skate, and summer flounder, which are all Federally managed species whose EFH has been designated in the mixing zone of the Delaware River (NFMS 2012). Anadromous fish in the mixing zone of the Delaware River include *Alosa* spp., such as American shad and river herring (NMFS 2012). These fish migrate between freshwater to spawn and marine waters as adults (Perillo and Butler 2009). During the migration to marine waters, anadromous fish pass through EFH-designated areas of the mixing zone of the Delaware River.

NRC staff reviewed the diet and life histories of species with EFH designated in the mixing zone of the Delaware River. The NRC staff determined that six species with EFH designated in the mixing zone of the Delaware River do not consume *Alosa* spp., including the following species and life stages:

- American plaice (*Hippoglossoides platessoides*), juvenile life stage
- Atlantic butterfish (*Peprilus triacanthus),* juvenile life stage
- Atlantic herring (*Clupea harengus*), juvenile life stage
- black sea bass (*Centropristus striata*), juvenile life stage
- scup (*Stenotomus chrysops*), juvenile life stage
- winter flounder (*Pleuronectes americanus*), *a*dult and juvenile life stages

A summary of the life history and food habits of these species can be found in Appendix A to this EFH Assessment. Given the substantial distance between the mixing zone of the Delaware River and the LGS cooling system, and because these species do not consume *Alosa* spp., the NRC staff determined that operation of the LGS cooling system would have **no adverse effects** on these species. Therefore, these species are not discussed in any additional detail within this EFH Assessment.

NRC staff determined that four species with EFH designated in the mixing zone of the Delaware River consume *Alosa* spp. These species and lifestages include the following:

- bluefish (*Pomatomus saltatrix*), *a*dult and juvenile life stages,
- summer flounder (*Paralicthys dentatus*), adult and uvenile life stages,
- windowpane flounder (*Scophthalmus aquosus)*, adult and juvenile stages, and
- winter skate (*Leucoraja ocellata*), adult and juvenile stages.

Section 3.2 describes the four species whose EFH has been designated in the mixing zone of the Delaware Bay and who prey upon anadromous species that may migrate to freshwater portions of the Delaware River or to the Schuylkill River or Perkiomen Creek. Section 3.3 describes the potential impacts adverse effects on EFH from the loss of prey species.

3.2 Description of EFH Species

Bluefish (*Pomatomus saltatrix):* Adult and Juvenile

<u>Designated EFH</u>

EFH for bluefish has not been designated in the Schuylkill River, Perkiomen Creek, or the portion of the Delaware River in which Point Pleasant Pumping Station is located. Designated EHF for bluefish includes the mixing zone of the Delaware River (NMFS 2012, 2014a).

Species Description and Diet

Adult and juvenile bluefish inhabit pelagic waters along the eastern United States. Juvenile bluefish generally occur in mid-Atlantic estuaries from May through October within the mixing and seawater zones (NFMS 2014b). Adult bluefish are found in mid-Atlantic estuaries from April through October and are in the mixing and seawater zones as well (NMFS 2014b). Juveniles inhabit estuaries as nursery areas that provide refuge from predators and sources of food. Adult bluefish are highly migratory (Fahay et al. 1999).

Adult bluefish primarily consume fish, whereas juveniles consume crustaceans, polychaetes, and fish. Fahay et al. (1999) summarized the results of several studies that suggest that adult and juvenile bluefish primarily eat whatever prey items are locally available and abundant. Bluefish consume a variety of fish. Stomach content studies have recorded up to 70 fish species within bluefish such as Atlantic butterfish, American sand lance (*Ammodytes americanus*), gizzard shad (*Dorosoma cepedianum*), anchovies (*Anchoa* spp.), silversides (*Menidia* spp.), killifish (*Fundulus* spp.), American shad, blueback herring, alewife, and other fish species (Fahay et al. 1999, Steimle et al. 2000). In the Hudson-Raritan Estuary, Steimle et al. (2000) examined the stomach contents of 63 juvenile bluefish. Dominant prey, based on the frequency of occurrence, included fish (Atlantic butterfish, silversides, anchovies, and juvenile black sea bass), sand shrimp (*Crangon septemspinosa*), and the mysid *Neomysis americana* (Steimle et al. 2000). Steimle et al. (2000) also reviewed the results of other stomach content studies for bluefish, which similarly concluded that main prey species included bay anchovy (*Anchoa mitchilli*), silversides, killifish, sand shrimp, and the mysid *Neomysis americana*. A few of these studies documented that bluefish consume American shad and blueback herring (e.g., de Sylva et al. 1962 in Steimle et al. 2000, Juanes et al.1993). Juanes et al. (1993) examined the diets of 374 juvenile bluefish collected in the Hudson River estuary and determined that juvenile bluefish fed opportunistically on the most abundant prey, which most commonly included bay anchovies, striped bass (*Morone saxatilis*), and white perch (*Morone americana*). Larger bluefish preferred Atlantic tomcod (*Microgadus tomcod*). In some samples, anadromous fishes, including striped bass, blueback herring, American shad, and Atlantic tomcod, constituted a large portion of the consumed fish prey. Atlantic tomcod do not occur in the Delaware Estuary.

Summer Flounder (*Paralicthys dentatus*): Adult and Juvenile

Designated EFH

EFH for summer flounder has not been designated in the Schuylkill River, Perkiomen Creek, or the portion of the Delaware River in which Point Pleasant Pumping Station is located. Designated EHF for summer flounder includes the mixing zone of the Delaware River (NMFS 2012, 2014a).

Species Description and Diet

Summer flounder are benthic fish that occur from Nova Scotia to Florida (Packer et al. 1999). Adult summer flounder migrate seasonally, from shallow coastal and estuarine waters during summer to offshore areas during the fall and winter (Lux and Nichy 1981 as cited in Packer et al. 1999, Packer et al. 1999). Adults and juveniles generally prefer sandy habitats.

Adult summer flounder are opportunistic feeders and prey upon a variety of fish and crustaceans (Bigelow and Schroeder 1953, Packer et al. 1999). Mysids (*Mysidopsis* spp.) are the dominant prey for juveniles, and fish, shrimp, squid, and polychaetes are primary prey for adults (NMFS 2014b). Common prey taxa for adults include windowpane flounder, winter flounder (*Pseudopleuronectes americanus*), northern pipefish (*Syngnathus fucus*), Atlantic menhaden (*Brevoortia tyrannus*), bay anchovy, red hake (*Urophycis chuss*), silver hake (*Merluccius bilinearis*), scup (*Stenotomus chrysops*), Atlantic silverside (*Menidia menidia*), American sand lance, bluefish, weakfish (*Cynoscion regalis*), mummichog (*Fundulus heteroclitus*), rock crabs (*Cancer* spp.), squids, shrimps, small bivalve and gastropod mollusks, small crustaceans, marine worms, and sand dollars (Packer et al. 1999). In Delaware Bay, Smith and Daiber (1977) examined the stomach contents from 131 flounder, ranging in size from 31 to 72.5 cm (12 to 28.5 in.). Dominant prey, based on frequency of occurrence, included sand shrimp (41 percent), weakfish (33 percent), and the mysid *Neomysis americana* (20 percent). Less common prey items included anchovies (7 percent), squid (*Loligo* sp., 4 percent), silverside (1 percent), herring (*Alosa* sp., 1 percent), hermit crab *(Pagurus longicarpus,* 1 percent), and isopod (*Olencira praegustator,* 1 percent). In the Hudson-Raritan Estuary, Steimle et al. (2000) examined the stomach contents of 229 juvenile and adult summer flounder and recorded over 35 prey species or items, including juvenile or small adult fish, decapod crustaceans, the mysid *Neomysis americana*, and other taxa. Dominant prey, based on the frequency of occurrence, included sand shrimp (34 to 78 percent) and the mysid *Neomysis americana* (0 to 34 percent). All other prey items, including *Alosa* spp., were each less than 10 percent. Steimle et al. (2000) classified *Alosa* spp. as minor prey species for summer flounder. Predators of adult summer flounder include large sharks, rays, and goosefish (*Lophius americanus*).

Windowpane Flounder (*Scophthalmus aquosus*): Adult and Juvenile

<u>Designated EFH</u>

EFH for windowpane flounder has not been designated in the Schuylkill River, Perkiomen Creek, or the portion of the Delaware River in which Point Pleasant Pumping Station is located. Designated EHF for windowpane flounder includes the mixing zone of the Delaware River (NMFS 2012, 2014a).

<u>Species Description and Diet</u>

Windowpane flounder inhabit estuaries, coastal waters, and oceans over the continental shelf along the Atlantic coast from the Gulf of Saint Lawrence to Florida. This species is most abundant from Georges Bank to Chesapeake Bay (Chang et al. 1999). Windowpane flounder spawn in estuaries. Juveniles migrate from estuaries to coastal waters during autumn, and they overwinter offshore in deeper waters. Adults remain offshore throughout the year but they inhabit nearshore waters in spring and autumn (Chang et al. 1999).

Juvenile and adult windowpane flounder have similar food sources, including mysids, decapod crustaceans, amphipods, copepods, mollusks, and larval or juvenile fish, such as hakes and Atlantic tomcod (Chang et al. 1999, Steimle et al. 2000). Steimle et al. (2000) examined the stomach contents of 570 juvenile and adult windowpane flounder taken from the Hudson-Raritan Estuary and recorded 37 different prey types, including juvenile *Alosa* spp., such as American shad, blueback herring, and alewife. Dominant prey, based on the frequency of occurrence, included the mysid *Neomysis americana* (34 to 93 percent), sand shrimp (24 to 53), and a suprabenthic amphipod (*Gammarus lawrencianus*) (<1 to 39 percent). All other prey items, including *Alosa* spp., were each less than 5 percent. Steimle et al. (2000) classified *Alosa* spp. as minor prey species for windowpane flounder. Predators include spiny dogfish (*Squalus acanthias*), thorny skate (*Amblyraja radiata*), goosefish, Atlantic cod (*Gadus morhua*), black sea bass (*Centropristis striata*), weakfish, and summer flounder (Chang et al. 1999).

Winter Skate (*Leucoraja ocellata*): Adult and Juvenile

<u>Designated EFH</u>

EFH for winter skate has not been designated in the Schuylkill River, Perkiomen Creek, or the portion of the Delaware River in which Point Pleasant Pumping Station is located. Designated EHF for winter skate includes the mixing zone of the Delaware River (NMFS 2012, NMFS 2014a).

<u>Species Description and Diet</u>

Winter skate occur from the south coast of Newfoundland and the southern Gulf of St. Lawrence to Cape Hatteras. Juvenile and adult winter skate generally inhabit Delaware Bay during winter, spring, and fall (Packer et al. 2003). Habitat includes waterbodies with sandy and gravel bottoms (Bigelow and Schroeder 1953).

Packer et al. (2003) reviewed several studies that examined the diet of winter skates and determined that the most important prey items in terms of numbers or occurrence include polychaetes and amphipods followed by decapods, isopods, bivalves, and fish. Fish become increasingly important within the diet of winter skates as they grow larger. American sand lance is the primary fish prey species (Packer et al. 2003). Other fish prey include smaller skates, eels, Atlantic menhaden, rainbow smelt (*Osmerus mordax*), American sand lance, chub mackerel (*Scomber japonicus*), Atlantic butterfish, cunners (*Tautogolabrus adspersus*), silver hake, Atlantic tomcod, yellowtail flounder (*Limanda ferruginea*), and longhorn sculpin (*Myoxocephalus octodecimspinosus*) (Packer et al. 2003). Steimle et al. (2000) examined the stomach contents of 57 adult winter skate within the Hudson-Raritan Estuary and determined that adult winter skate consume a diverse variety of benthic invertebrates and fish. Commonly consumed prey included sand shrimp and fish, such as Atlantic herring (*Clupea harengus*), longhorn sculpin, American sand lance, and winter flounder. Bigelow and Schroeder (1953) noted that winter skate may consume *Alosa* spp.

3.3 Potential Adverse Effects to Essential Fish Habitat

The provisions of the regulations implementing the MSA define an “adverse effect” to EFH as the following (50 CFR 600.810, “Definitions and Word Usage”):

> *Adverse effect* means any impact that reduces quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

EFH has not been designated in the Schuylkill River, Perkiomen Creek, or the portion of the Delaware River in which Point Pleasant Pumping Station is located (NFMS 2012, 2014a). However, the prey of some species with EFH designated in the mixing zone of the Delaware River migrate from EFH designated areas in the Delaware River to the Schuylkill River, Perkiomen Creek, and upstream in the freshwater portion of the Delaware River in which the Point Pleasant Pumping Station is located.

In 50 CFR 600.815 (a)(7), adverse effects on EFH from a loss of prey species is defined as follows:

> Loss of prey may be an adverse effect on EFH and managed species because the presence of prey makes waters and substrate function as feeding habitat, and the definition of EFH includes waters and substrate necessary to fish for feeding. Therefore, actions that reduce the availability of a major prey species, either through direct harm or capture, or through adverse impacts to the prey species' habitat that are known to cause a reduction in the population of the prey species, may be considered adverse effects on EFH if such actions reduce the quality of EFH.

To determine whether operation of the LGS cooling system could result in adverse effects to EFH, the NRC staff assessed the following questions:

1. Are *Alosa* spp. major prey species for fish with designated EFH within the mixing zone of the Delaware River?
2. Would operation of the LGS cooling system result in direct harm or capture that is known to cause reductions in the population of *Alosa* spp.?
3. Would operation of the LGS cooling system result in adverse impacts to *Alosa* spp. habitat that are known to cause reductions in the population of *Alosa* spp.?

Prey Species

To determine whether operation of the LGS cooling system could result in adverse effects to EFH, the NRC staff assessed whether *Alosa* spp. are major prey species for adult and juvenile bluefish, summer flounder, windowpane flounder, and winter skate.

Bluefish are opportunistic feeders that tend to consume a wide variety prey, depending on what prey is locally available and abundant (Fahay et al. 1999). The most commonly documented fish prey did not include *Alosa* spp. (Fahay et al. 1999, Steimle et al. 2000). Juanes et al. (1993), however, documented that anadromous fishes, including striped bass, blueback herring, American shad, and Atlantic tomcod (which do not occur in the Delaware Estuary), constituted a large portion of the bluefish diet the Hudson River Estuary. Therefore, the NRC staff concludes that *Alosa* spp. are typically not major prey species for bluefish. However, in situations where *Alosa* spp. are locally abundant and available, *Alosa* spp. could be major prey species for adult and juvenile bluefish.

Adult summer flounder are opportunistic feeders and prey upon a variety of fish and crustaceans (Bigelow and Schroeder 1953, Packer et al. 1999). Juvenile summer flounder primarily consume mysids (*Mysidopsis* spp.) (NMFS 2014b). In Delaware Bay, Smith and Daiber (1977) examined the stomach contents from 131 summer flounder, of which river herring where approximately 1 percent of the diet. In the Hudson-Raritan Estuary, Steimle et al. (2000) examined the stomach contents of 229 juvenile and adult summer flounder and determined that *Alosa* spp., were less than 10 percent of the diet. Steimle et al. (2000) classified *Alosa* spp. as minor prey species for summer flounder. Therefore, the NRC staff concludes that *Alosa* spp. are not major prey species for adult and juvenile summer flounder.

Juvenile and adult windowpane flounder consume mysids, decapod crustaceans, amphipods, copepods, mollusks, and larval or juvenile fish, such as hakes and Atlantic tomcod (Chang et al. 1999, Steimle et al. 2000). Steimle et al. (2000) examined the stomach contents of 570 juvenile and adult windowpane flounder within the Hudson-Raritan Estuary and determined that *Alosa* spp. were less than 5 percent of the diet. Steimle et al. (2000) classified *Alosa* spp. as minor prey species for windowpane flounder. Therefore, the NRC staff concludes that *Alosa* spp. are not major prey species for adult and juvenile windowpane flounder.

Winter skates primarily consume polychaetes and amphipods followed by decapods, isopods, bivalves, and fish (primarily American sand lance) (Packer et al. 2003). Steimle et al. (2000) examined the stomach contents of 57 adult winter skate taken from the Hudson-Raritan Estuary and did not report any occurrences where winter skate consume *Alosa* spp. Bigelow and Schroeder (1953) noted that winter skate may consume *Alosa* spp. Given that *Alosa* spp. have rarely been reported as prey for winter skate, the NRC staff concludes that *Alosa* spp. are not major prey species for adult and juvenile winter skate.

Direct Harm or Capture of Prey Species

Operation of the LGS cooling system could result in direct harm or capture of prey species if *Alosa* spp. experience impingement or entrainment, heat or cold shock, or exposure to radionuclides. The effects could be an adverse impact on EFH if they are known to cause a reduction in the population of *Alosa* spp.

Impingement and Entrainment

Alosa spp. could be impinged or entrained during the intermittent withdrawal of water for the LGS cooling system. Blueback herring and alewife eggs are demersal and adhesive, which make them less likely to be entrained. Nonetheless, eggs and larvae entrained in the intakes on the Perkiomen Creek and Schuylkill River would directly enter the LGS cooling system and would no longer be available as prey. On the Delaware River, eggs and larvae entrained in the Point Pleasant Pumping Station would be transported from the Delaware River to the East Branch Perkiomen Creek. Eggs and larvae would experience sudden pressure fluctuations, velocity shear forces, and physical abrasion in the pumps at Point Pleasant and Bradshaw Reservoir and throughout the pipeline. If any of the eggs or larvae of prey species survive the transport, successful development would depend on organisms finding suitable habitat. Prey species that survive the transport may continue to provide food for EFH species if they are able to successfully migrate to the Delaware River Estuary post-transport. For the purposes of this analysis, the NRC staff did not assume that prey species survive transport or migrate back to EFH designated areas.

The License Renewal GEIS assessed the impacts to aquatic resources that are known to occur at all operating reactors, and the LGS SEIS assessed additional site-specific information related to potential impacts on aquatic resources as a result of the LGS cooling system (NRC 2013a, 2013b). As described in the GEIS and the LGS SEIS, the NRC staff determined that impacts from impingement and entrainment would be "SMALL" and would not noticeably alter aquatic resources (including *Alosa* spp.) due to the use of a closed-cycle cooling system that withdraws substantially less water than that of a once-through system (NRC 2013a, 2013b). NRC defines "SMALL" as "environmental effects [that] are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource" (Table B-1 of Appendix B, "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant," to Subpart A, "National Environmental Policy Act—Regulations Implementing Section 102(2)," of 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions"). In addition, impingement and entrainment is reduced at LGS due to the use of traveling screens at the Schuylkill River intake, the use of wedge-wire screens and the low average through-slot velocity (0.4 fps [0.12 m/s]) at the Perkiomen Creek intake, and the use of wedge-wire screens and the low average intake velocity (0.35 fps [0.11m/s]) at the Point Pleasant Pump House on the Delaware River (NRC 2013a, 2013b). Given that impingement and entrainment would not noticeably alter aquatic resources near LGS, including anadromous prey species and their habitat, the NRC staff concludes that impingement and entrainment of *Alosa* spp. would not result in direct harm or capture that is known to cause reductions in the population of *Alosa* spp.

<u>Heat Shock and Cold Shock</u>

Direct harm could result from heat shock if fish swim through the thermal discharge in the Schuylkill River. Similarly, cold shock could occur to individuals resident on the thermal plume during periods when no thermal effluent is released. However, the flow, temperature, and other conditions of the discharge are regulated by LGS's NPDES Permit No. PA0051926. In addition, fish are mobile and could swim away to avoid the thermal plume. As described in the GEIS and the LGS SEIS, the NRC staff determined that impacts from heat and cold shock would be SMALL and would not noticeably alter aquatic resources, including *Alosa* spp. (NRC 2013a, 2013b). Given that heat and cold shock would not noticeably alter aquatic resources near LGS, including anadromous prey species and their habitat, the NRC staff concludes that heat and cold shock would not result in direct harm or capture that is known to cause reductions in the population of *Alosa* spp.

<u>Exposure to Radionuclides</u>

The License Renewal GEIS and the LGS SEIS considered the impacts to aquatic organisms from exposure to radionuclides during the license renewal term (NRC 2013a, 2013b). In the LGS SEIS, the NRC staff describes Exelon's radioactive waste management program to control radioactive effluent discharges to ensure that they comply with NRC regulations in 10 CFR Part 20, "Standards for protection against radiation." In addition, the NRC staff evaluated potential impacts by reviewing LGS's radioactive effluent and radiological environmental monitoring programs. Based on Exelon's radioactive waste management program and Exelon's radioactive effluent and radiological environmental monitoring programs, and the information in the GEIS that is applicable to all operating nuclear reactors, the NRC staff concluded in the LGS SEIS that the impacts to aquatic organisms from exposure to radionuclides would not noticeably alter aquatic resources near LGS, including anadromous prey species and their habitat. Therefore, the NRC staff concludes that exposure to radionuclides would not result in direct harm or capture that is known to cause reductions in the population of *Alosa* spp.

<u>Adverse Impacts to the Prey Species' Habitat</u>

The LGS SEIS examined the following impacts to aquatic resources that could occur during the period of continued operations, and that could result in adverse impacts to prey species' habitat, including the following:

- accumulation of contaminants in sediments or biota
- entrainment of phytoplankton and zooplankton
- thermal plume barrier to migrating fish
- distribution of aquatic organisms
- premature emergence of aquatic insects
- gas supersaturation (gas bubble disease)
- low dissolved oxygen in the discharge
- losses from predation, parasitism, and disease among organisms exposed to sublethal stresses

- stimulation of nuisance organisms (NRC 2013a)

In the LGS SEIS, the NRC staff concluded that all impacts to aquatic resources, including anadromous fish such as *Alosa* spp., would be "SMALL" and would not be detectable or would be so minor that they would neither destabilize nor noticeably alter any important attribute of aquatic resources. The NRC staff concludes that mitigation measures for impacts that are "SMALL" are not likely to be sufficiently beneficial to warrant implementation. Similarly, the NRC staff believes that stressors with "SMALL" levels of impact would not adversely affect EFH.

In addition, this assessment considers potential impacts to the habitat quality for anadromous prey species caused by water augmentation projects and LGS water use on the Schuylkill River, which is the water source that is most often used for LGS makeup water (NRC 2013a). LGS license renewal would not involve new construction, refurbishment, ground-disturbing activities, or changes to existing land use conditions at the LGS site and throughout the cooling system (Exelon 2011).

Augmentation Activities

To help maintain sufficient flow within the Schuylkill River, DRBC allows Exelon to augment the flow through releases of water from other sources, including Wadesville Mine Pool and the Still Creek Reservoir. Normandeau Associates, Inc. (NAI) and URS Corporation (URS) (2004 and 2011) conducted monitoring studies to determine the potential effects of the Wadesville Mine Pool augmentation on aquatic biota. Monitoring studies during the first year of the project in 2003 indicated that the flow augmentation had no effect on water quality parameters such as total dissolved solids and pH (NAI and URS 2004). Aquatic biota monitoring included an assessment of macroinvertebrate and fish community composition and abundances before and after initiation of the project in 2003 at upstream and downstream locations of the Norwegian Creek confluence with the Schuylkill River (NAI and URS 2004). NAI and URS sampled macroinvertebrates with kick nets and fish with electroshocking. Before the initiation of the demonstration project, predominant fish species included blacknose dace (*Rhinichthys atratulus*), creek chub (*Semotilus atromaculatus*), white sucker (*Catostomus commersonii*), and green sunfish (*Lepomis cyanellus*), and macroinvertebrate sampling revealed limited species diversity with decapods, oligochaetes, and Trichoptera comprising the majority of samples. Fish abundances and community composition remained similar following the commencement of the augmentation of flows from the Wadesville Mine Pool. However, macroinvertebrate diversity and abundance increased below the confluence of Norwegian Creek and the Schuylkill River (NAI and URS 2004). More recently, NAI and URS (2011) reported no significant changes to water quality or aquatic biota species diversity or abundances within the Schuylkill River due to releases of water from the Wadesville Mine Pool using sampling methods described for the initial study conducted in 2003.

When low flows restrict LGS from withdrawing makeup water from the Schuylkill River, Exelon alternatively withdraws makeup water from Perkiomen Creek. LGS augments the flow in the Perkiomen Creek through surface water diversion from the Delaware River to Perkiomen Creek (Section 2.2). Indirect effects to anadromous prey species could occur from the Delaware River intrabasin transfer of water, which involves diversion of Delaware River water to the East Branch Perkiomen Creek that discharges by gravity flow to Perkiomen Creek to augment the flow in Perkiomen Creek (Figure 5). After the initiation of the Point Pleasant water diversion project, which transported water from the Delaware River to East Branch Perkiomen Creek, NAI (2010a, 2010b) sampled macroinvertebrates in the East Branch Perkiomen Creek between 2001 and 2009 using methods similar to those used in the 1980s. This study was part of an analysis to examine post-operational effects of the Point Pleasant water diversion effort (Exelon 2011b). NAI (2010a, 2010b) observed similar levels of macroinvertebrate species diversity as compared to pre-diversion sampling. Midges and oligochaetes dominated samples both before and after the diversion project. However, after the diversion project, less variability existed along the stream gradient and pollution-sensitive species increased in abundance over time (NAI 2010a, 2010b).

Given that the fish and macroinvertebrate abundances and community composition remained relatively similar following the commencement of the augmentation of flows in the Schuylkill River and Perkiomen Creek, the NRC staff concludes that augmentation activities would not result in adverse impacts to habitat that are known to cause reductions in the population of *Alosa* spp.

LGS Water Use on the Schuylkill River

Exelon primarily withdraws water from the Schuylkill River for the LGS cooling system. To limit downstream water quality and aquatic impacts in the Schuylkill River during periods of low flow, the DRBC does not allow LGS to withdraw water for consumptive use when the river flow falls below 560 cfs (15.9 m^3/s), based on two-unit operation (Section 2.2.1). During these situations, LGS withdraws makeup water from Perkiomen Creek. The DBRC requirement that LGS shift to alternative water sources ensures that LGS cooling water withdrawals and associated consumptive use will not reduce river flow by more than 12 percent during low-flow periods. During average flows, LGS operations will reduce the flow by about 3 percent. Therefore, DRBC imposes requirements to ensure that LGS's consumptive water use from the Schuylkill River remains within acceptable limits and will not noticeably alter downstream water availability and aquatic resources.

To examine potential impacts to the aquatic community from LGS operations, NAI (2010c) compared the fish community in the Schuylkill River from 1987 to 2009. The NRC staff notes that the timing and frequency of sampling efforts varied slightly among studies: NAI (2010c) conducted electrofishing and seining surveys in September and October, whereas RMC Environmental Services (RMC) conducted sampling studies in the 1980s from spring through fall. The most commonly collected species in 2009 were spotfin shiner (*Cyprinella spiloptera*) (73.8 percent of the total catch), swallowtail shiner (*Notropis procne*) (8.1 percent of the total catch), banded killifish (*Fundulus heteroclitus*) (3.7 percent of the total catch), and tessellated darter (*Etheostoma olmstedi)* (3.4 percent of the total catch) (NAI 2010c). In 1987, spotfin shiner was also the most abundant species, although the relative abundance (53.9 percent of the total catch) was lower compared to the 2009 surveys. NAI (2010c) collected all age groups of fish (fry, juveniles, and adults) for most fish families observed, with the exception of sunfishes, which were primarily fry and juveniles. NAI electroshocking surveys collected primarily adult and juvenile redbreast sunfish (*Lepomis auritus*) (27.7 percent of the total catch). Other commonly collected species included white sucker (17.4 percent of the total catch), rock bass (*Ambloplites rupestris)* (17.2 percent of the total catch), common carp (*Cyprinus carpio)* (16.9 percent of the total catch), and smallmouth bass *(Micropterus dolomieu)* (8.3 percent of the total catch). In 1987, the most abundant species was rock bass (19.0 percent of the total catch) followed by goldfish (*Carassius auratus auratus*) (17.6 percent of the total catch), redbreast sunfish (15.7 percent of the total catch), yellow bullhead (*Ameiurus natalis)* (8.8 percent of the total catch), and pumpkinseed (*Lepomis gibbosus*) (8.6 percent of the total catch). Despite the increased sampling frequency during earlier fish surveys, NAI (2010c) concluded that the overall species diversity was similar to the earlier fish surveys by RMC in 1987. However, the relative abundance of certain species changed between 1987 and 2009.

For example, common carp replaced goldfish as one of the more abundant species in 2009 (NAI 2010c). In addition, goldfish (an introduced species) were not collected in 2009 and a single brown bullhead was collected in 2009. Both of these species were among the five most commonly collected species during 1987 surveys.

Based on DRBC's restrictions during low flows and the relatively similar fish community over time, the NRC staff concludes that LGS water use on the Schuylkill River would not result in adverse impacts to habitat that are known to cause reductions in the population of *Alosa* spp.

4.0 Cumulative Impacts to Essential Fish Habitat

This section addresses the cumulative impacts to anadromous prey that are consumed by species with EFH designated in the mixing zone of the Delaware. Cumulative impacts include the aggregate effect from past, present, and reasonably foreseeable activities, no matter who has taken the actions (*i.e.,* Federal agencies, non-Federal agencies, or private activities).

Historically, the direct and indirect impacts from water use and industrial discharge, such as mining waste water, were some of the most influential human activities on the Delaware River Basin (DRBC 2010). Within the Schuylkill River, Perkiomen Creek, and East Branch Perkiomen Creek, increased urbanization over the past 100 years has also led to increased runoff and elevated levels of pollutants (Rhoads and Block 2008).

The Schuylkill River and Perkiomen Creek once supported large numbers of anadromous fishes such as the American shad, alewife, and river herring (or blueback herring). Anadromous fish would migrate from the Atlantic Ocean to the Delaware and Schuylkill Rivers to spawn. However, construction of the Fairmont Dam, built in 1820, and eight subsequent dams built in the 1800s cut off access to upriver spawning locations for anadromous fish. Starting in the 1970s, fish passage systems, such as vertical fish slots and the removal of dams along the Schuylkill River, have helped to reestablish migration upriver. For example, the Pennsylvania Fish and Boat Commission (PFBC) conducted fish ladder passage counts in 2004 and 2005 and observed a total of 91 and 41 American shad migrating upriver, respectively (PFBC 2014).

Many natural and anthropogenic activities can influence the current and future aquatic biota in the area surrounding the LGS site and the Delaware River Basin. Potential biological stressors include operational impacts from LGS (as described above and in Section 4.6 of the LGS SEIS), increasing urbanization, energy development and water use, and climate change.

<u>Urbanization and Water Quality</u>

In general, water quality across the Delaware River Basin has dramatically improved over the past several decades. The water quality of the Delaware River and its main tributaries, such as the Schuylkill River, was profoundly impaired by municipal and industrial waste discharges and mining activities. Regulatory changes, including implementation of the Clean Water Act, have eliminated many of the largest point and nonpoint sources of water quality degradation. Still, within this context, the trend in urban and suburban development in the immediate LGS region (see Sections 4.12.3 and 4.12.4 of the LGS SEIS) and associated corridor-type development (e.g., roads) to keep pace with overall population growth in the Delaware River Basin has introduced a different impact dynamic. From the perspective of water quality, these types of developments generally substitute more diffuse sources of pollution (i.e., nonpoint) and their impacts for point sources traditionally associated with industry.

Nevertheless, the segment of the Schuylkill River near LGS meets all established water quality standards at present, as described in Section 2.2.4.2 of the LGS SEIS (NRC 2013a). The

DRBC is responsible for classifying all waters in the basin as to use, setting basin-wide water quality standards, establishing pollutant treatment and control regulations, and reviewing projects or other undertakings with the potential to affect basin water resources for conformance with the DRBC Comprehensive Plan (DRBC 2001). DRBC acts in coordination with the States and other parties that are signatories to the DRBC Compact (DRBC 1961) to include the imposition of necessary effluent limitations on industrial wastewater discharges to surface water.

Several other facilities within 10 mi (16 km) of LGS have NPDES permits to discharge into the Schuylkill River, which contributes to the cumulative impacts to aquatic habitats (EPA 2012). For example, six municipal wastewater treatment facilities discharge treated wastewater to the Schuylkill River for a total discharge of less than 9 mgd. In addition, at least seven major industrial facilities, such as industrial laundry facilities, chemical production facilities, and aluminum die casting facilities, discharge into the Schuylkill River. Two municipal facilities and one industrial treatment facility discharge to Perkiomen Creek with a maximum total discharge of 2.0 mgd. Three major industrial facilities with NPDES permits for water discharge to Perkiomen Creek exist within a 10-mi (16-km) radius of LGS. Little effect to aquatic habitats from industrial and wastewater discharges is expected, assuming that facilities comply with NPDES permit limitations.

Future impacts to water quality could be influenced by changes in land use. Interlandi and Crockett (2003) reported an increase in residential and commercial development for the area surrounding LGS along the Schuylkill River, Perkiomen Creek, and East Branch Perkiomen Creek, and a decrease in population near Philadelphia, Pennsylvania. Increased urbanization has led to increases in dissolved nitrate and chloride levels in the Schuylkill River. Urbanization will likely continue to contribute significant organic and metal pollutants to the river through runoff (Interlandi and Crockett 2003). The DRBC and EPA manage and set total maximum daily load limits for contaminants, such as polychlorinated biphenyl, to help control future pollution of waters within the Delaware River Basin (DRBC 2008, EPA 2007).

Energy Development and Water Use

A number of energy plants withdraw water from the Schuylkill and Delaware Rivers. Within 30 mi (48 km) of LGS, one oil plant and one natural-gas plant also withdraw and discharge to the Schuylkill River. In 2011, Exelon decommissioned two coal-fired units on the Schuylkill River at Cromby Generating Station. Two municipal facilities and one industrial treatment facility records show Eddystone Generating Station Coal Plant at 897 million gallons per year (MGY) (3.4 million m^3), Company Marcus Hook Gas Plant at 1,018 MGY (3.85 million m^3), and Fairless Energy, LLC at 495 MGY (1.87 million m^3) (DRBC 2012b). Furthermore, the DBRC Comprehensive Plan (DRBC 2001) considers LGS and other energy users. The DBRC's mission includes water conservation, control, use, and management, which is accomplished through the adoption and promotion of uniform and coordinated policies basin-wide (DRBC 1961).

Marcellus shale formation underlies approximately 36 percent of the Delaware River Basin and energy companies are actively seeking to mine the natural gas deposits within the Marcellus shale formation (DRBC 2012c, PDEP 2013). Several impacts to aquatic habitat could occur during the mining process, including physical habitat disturbance at the drill site; the potential to add, discharge, or cause the release of pollutants into waterbodies near the drill site; reduced water flow whereby water is withdrawn to support mining operations; and degradation of aquatic habitat if recovered "frac water" is not properly treated before discharge into waterbodies (DRBC 2012c). Direct impacts to aquatic biota could occur if aquatic organisms are immobile or unable to avoid the drill site. The Pennsylvania Department of Environmental Protection currently regulates the drilling of Marcellus shale in the State. This oversight includes reviewing and issuing drilling permits, inspecting drilling operations during both routine and unannounced inspections, and responding to complaints about water quality issues (PDEP 2014).

Climate Change

The U.S. Global Climate Research Program (USGCRP), reports that from 1895 to 2012, U.S. average surface temperatures have increased by 1.3 degree F to 1.9 degree F (0.72 to 1.06 degree C) (USGCRP 2014). Climate change research indicates that the cause of the observed warming is due to the buildup of greenhouse gases in atmosphere resulting from human activities (USGCRP 2014). The effects of global climate change are already being felt in the northeastern United States, in which Limerick is located. For the Northeast region, average air temperatures between 1895 and 2011 increased by 2 degrees F (1.1 degree C) and precipitation increased by more than 10 percent (USGCRP 2014). Between 1958 and 2010, the Northeast region experienced a 70 percent increase in heavy precipitation events, the largest increase of any region in the United States (USGCRP 2014). Other climate-related changes in the Northeast region include a rise in sea level by 1 ft (0.3 m) since 1900, a rate that exceeds the global average of 8 in. (20 cm) (USGCRP 2014). Temperatures, precipitation, and runoff are projected to continue to increase and sea level is expected to continue to rise. Although great uncertainty exists, sea levels are expected to rise between 0.5 and 1.5 ft (0.15 to 0.46 m) by 2050 and by 1 to 4 ft (0.3 to 1.2 m) by the end of this century; the rise in sea level along the Northeast coast is expected to exceed the global rate because of local land subsidence (USGCRP 2014). Meanwhile, precipitation and runoff are projected to increase in the winter and spring across the Northeast. Increased runoff generally results in increased stream flow.

The impacts of climate change on aquatic communities within the Delaware River Basin may be substantial and may subsequently affect aquatic resources in the region. For example, seasonal spawning may shift earlier to coincide with earlier spring flows from higher temperatures melting snowpack earlier in the season. Increased water temperatures and higher sea levels may result in anadromous fish migrations further up the Delaware or Schuylkill Rivers. Further degradation of water quality from increased runoff following heavy precipitation events may compromise sensitive life stages of aquatic species in associated watersheds and may have noticeable effects on aquatic populations.

Interlandi and Crockett (2003) examined the relative influences of climate change and stormwater discharge on the Schuylkill River Basin from 1895 to 1999 using temperature, precipitation, and river discharge data. Although seasonal variations exist, the overall influence of long-term climate change showed marginal influence because increasing urbanization and increased stormwater discharge had a larger direct effect on water quality (Interlandi and Crockett 2003). Therefore, stormwater discharges may play a larger role than that of climate change in cumulative changes to aquatic biota in the future.

5.0 Essential Fish Habitat Conservation Recommendations

Exelon implements a number of features and operational controls that avoid, minimize, or offset potential adverse impacts to EFH. For example, several features and operational controls of the LGS cooling system minimize the direct harm and capture of prey species and the degradation of habitat for prey species, including the following:

- LGS cooling system currently operates using a closed-cycle cooling system that minimizes impingement and entrainment, which can cause direct harm and capture.
- The intake on the Schuylkill River has four travelling screens with 0.25-inch (in.) (0.64-cenimeter [cm]) mesh openings and water approaches the screens at a velocity of 0.61 feet per second (fps) (0.19 meter per second [m/s]) (Exelon 2012a, Exelon 2013, DRBC 2013a). The screens and low approach velocity minimize impingement and entrainment, which can cause direct harm and capture.
- The intake on the Perkiomen Creek has 15 submerged, stationary "wedge-wire" screens with a slot size of 0.08 in. (0.2 cm). The screens have an average through-slot velocity of 0.4 fps (0.12 m/s). The screens and low through-slot velocity minimize impingement and entrainment, which can cause direct harm and capture.
- The Point Pleasant Pumphouse intake structure consists of two rows of fixed cylindrical wedge-wire screens, with each row comprised of 12 screens. Screens have a slot size of 0.08 in. (0.2 cm). At the maximum pumping rate of 95 mgd (360,000 m^3/d), the average intake water velocity is 0.35 fps (0.11 m/s). The screens and low through-slot velocity minimize impingement and entrainment, which can cause direct harm and capture.
- Blowdown discharged to the Schuylkill River is regulated under LGS's Pennsylvania NPDES permit (No. PA0051926), subject to DRBC docket provisions. In addition, LGS uses a diffuser to limit the size of the thermal mixing zone (Exelon 2011), which reduces degradation to prey species habitat.
- All surface water withdrawals from the Schuylkill River by LGS are regulated by the DRBC, which restricts LGS from withdrawing makeup water from the Schuylkill River during periods of low flows and which reduces degradation to prey species habitat.

6.0 Conclusions

As previously described in Section 3.0, and supported by the information included in Appendix A, the NRC staff concludes that operation of the LGS cooling system would result in **no adverse effects** to EFH for juvenile American plaice, juvenile Atlantic butterfish, juvenile Atlantic herring, juvenile black sea bass, juvenile scup, and juvenile and adult winter flounder given the substantial distance between the mixing zone of the Delaware River and the LGS cooling system and because these species do not consume anadromous prey that migrate to freshwaters near the LGS cooling system.

The NRC staff concludes that the proposed LGS license renewal would have **minimal adverse effects** on EFH for juvenile and adult bluefish, juvenile and adult summer flounder, juvenile and adult windowpane flounder, and juvenile and adult winter skate for the following reasons:

- Impacts to EFH species would be limited to loss of prey (forage) species that migrate substantial distances between the EFH designated area of the mixing zone in the Delaware River and freshwater portions of the Delaware River, Schuylkill River, and Perkiomen Creek.
- Anadromous fish that migrate from EFH designated areas to freshwater portions of the Delaware River, Schuylkill River, or Perkiomen Creek would be the only prey species potentially affected by LGS operations due to the

substantial distance between EFH designated areas and the LGS cooling system.

- Anadromous fish (e.g. *Alosa* spp.) do not appear to be major prey for summer flounder, windowpane flounder, or winter skate. Typically, *Alosa* spp. are not major prey for bluefish; however *Alosa* spp. could be major prey if they are locally abundant and available within the mixing zone of the Delaware River.
- Operation of the LGS cooling system would not result in the direct harm or capture that is known to cause reductions in the population of *Alosa* spp. because of the following reasons:
    - No new construction, refurbishment, ground-disturbing activities, or changes to existing land use conditions would occur at the Schuylkill Pump Station, or Perkiomen Creek Station Point Pleasant Pumping Station.
    - Impingement and entrainment of anadromous fish would be minimized due to the closed-cycle cooling system and the use of wedge-wire or traveling screens at all intakes.
    - Heat and cold shock would be minimized due to the relatively small size of the thermal plume, the ability of fish to swim away and avoid the plume, and the temperature and other conditions of the discharge that are regulated by LGS's NPDES permit.
    - Exposure to radionuclides would not noticeably alter aquatic resources near LGS, including anadromous prey species and their habitat, based on Exelon's radioactive waste management program, Exelon's radioactive effluent and radiological environmental monitoring programs, and the information in the GEIS that is applicable to all operating nuclear reactors.
- Operation of the LGS cooling system would not result in adverse impacts to *Alosa* spp. habitat that are known to cause reductions in the population of *Alosa* spp. because of the following reasons:
    - No new construction, refurbishment, ground-disturbing activities, or changes to existing land use conditions would occur at the Schuylkill Pump Station, or Perkiomen Creek Station Point Pleasant Pumping Station.
    - In the LGS SEIS, the NRC staff determined operation of the LGS cooling system would not noticeably alter aquatic habitat, including *Alosa* spp. habitat, as the result the accumulation of contaminants in sediments or biota, entrainment of phytoplankton and zooplankton, thermal plume barrier to migrating fish, distribution of aquatic organisms, premature emergence of aquatic insects, gas supersaturation (gas bubble disease), low dissolved oxygen in the discharge, losses from predation, parasitism, and disease among organisms exposed to sublethal stresses, or stimulation of nuisance organisms.
    - Studies examining the effects from augmenting the flow in the Schuylkill River, the East Branch Perkiomen Creek, and Perkiomen Creek have concluded that augmentation activities have not degraded aquatic habitats for fish; and

- All surface water withdrawals by LGS are regulated by the DRBC, which restricts LGS from withdrawing makeup water from the Schuylkill River during periods of low flows. In addition, ecological studies on the Schuylkill River have shown a relatively similar fish community over time.

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Appendix A: Life History and Food Habits of Species for which the Operation of Limerick Generating Station would have "No Adverse Effect"

American Plaice (*Hippoglossoides platessoides*): Juvenile

Designated EFH

EFH for American plaice has not been designated in the Schuylkill River, Perkiomen Creek, or the portion of the Delaware River in which Point Pleasant Pumping Station is located. Designated EHF for juvenile American plaice includes the mixing zone of the Delaware River (NMFS 2014a).

Species Description and Diet

American plaice are arctic-boreal pleuronectid flatfish (Johnson 2005). American plaice inhabit both sides of the Atlantic Ocean. American plaice juveniles and adults includes bottom habitats with fine-grained, sandy, or gravel substrates (NMFS 2014b). American plaice are relatively sedentary, and tagging studies have indicated that few migrate long distances.

American plaice consume a wide-variety of prey and are opportunistic feeders, in that they will consume what is most available (Johnson 2005). Prior to settling on the ocean floor, juveniles feed on small crustaceans—such as cumaceans—and polychaetes (Bigelow and Schroeder 1953). NMFS (2014b) reports major prey to include echinoderms, arthropods, annelids. In Maine and Canada, a few studies have documented that American plaice will consume fish, such as Atlantic herring (Johnson 2005). Johnson (2005) reviewed various feeding studies of American plaice and did not note any studies where American plaice consumed *Alosa* spp.

Atlantic Butterfish (*Peprilus triacanthus)*: Juvenile

Designated EFH

EFH for Atlantic butterfish has not been designated in the Schuylkill River, Perkiomen Creek, or the portion of the Delaware River in which Point Pleasant Pumping Station is located. Designated EHF for juvenile Atlantic butterfish includes the mixing zone of the Delaware River (NMFS 2014a).

Species Description and Diet

Juvenile Atlantic butterfish are found in waters from 33 to 1,200 ft (10 to 366 m) deep and at temperatures ranging from 37 to 82° F (3 to 28° C) (Cross et al. 1999). From spring through fall, juvenile Atlantic butterfish inhabit pelagic waters within estuaries (NMFS 2014b). Juveniles are schooling fish, and smaller individuals may associate with floating objects, such as jellyfish (NMFS 2014b).

Atlantic butterfish prey mainly on urochordates and mollusks, with minor food sources including squid, crustaceans (such as amphipods and shrimp), annelid worms, and small fishes (Bigelow and Schroeder 2002, Cross et al. 1999). Cross (et al. 1999) reviewed various feeding studies of Atlantic butterfish and did not note any studies where Atlantic butterfish consumed *Alosa* spp.

Atlantic Herring (*Clupea harengus*): Juvenile

Designated EFH

EFH for Atlantic herring has not been designated in the Schuylkill River, Perkiomen Creek, or the portion of the Delaware River in which Point Pleasant Pumping Station is located. Designated EHF for juvenile Atlantic herring includes the mixing zone of the Delaware River (NMFS 2014a).

Species Description and Diet

Atlantic herring are pelagic, schooling fish that inhabit both the eastern and western Atlantic Ocean (Stevenson and Scott 2005). Schooling behavior begins as fish develop into juveniles. In Delaware Bay, juveniles inhabit pelagic waters and bottom habitats (NMFS 2014b).

Juvenile Atlantic herring are opportunistic feeders and prey on up to 15 different groups of zooplankton. The most common prey items for juveniles include copepods, decapods larvae, barnacle larvae, cladocerans, and molluscan larvae (Sherman and Perkins 1971 as cited in Stevenson and Scott 2005). The Northeast Fisheries Science Center's bottom trawl surveys from 1973-2001 did not observe fish or fish larvae as part of the diet for juvenile Atlantic herring (Stevenson and Scott 2005).

Black Sea Bass (*Centropristus striata*): Juvenile

Designated EFH

EFH for black sea bass has not been designated in the Schuylkill River, Perkiomen Creek, or the portion of the Delaware River in which Point Pleasant Pumping Station is located. Designated EHF for juvenile black sea bass includes the mixing zone of the Delaware River (NMFS 2014a).

Species Description and Diet

Juvenile black sea bass can be found in the Delaware estuary during spring and summer (NMFS 2014b). Juveniles inhabit rivers and estuaries with rough bottoms, shellfish and eelgrass beds, or man-made structures in sandy-shelly areas (NMFS 2014b). Black sea bass begin life as a female and change sex and become males after 2 to 5 years of age (Drohan et al. 2007).

Primary prey items for juvenile black sea bass include crustaceans, such as shrimp, isopods, and amphipods, sand shrimp, copepods, and mysids (ASMFC 1996, Drohan et al. 2007). Juveniles also consume small fish, although crustaceans appear to be the primary prey (Drohan et al. 2007). Dorhan et al. (2007) and Steimle et al. (2000) reviewed various feeding studies of black sea bass and did not note any studies where black sea bass consumed *Alosa* spp.

Scup (*Stenotomus chrysops*): Juvenile

Designated EFH

EFH for scup has not been designated in the Schuylkill River, Perkiomen Creek, or the portion of the Delaware River in which Point Pleasant Pumping Station is located. Designated EHF for juvenile scup includes the mixing zone of the Delaware River (NMFS 2014a).

Species Description and Diet

Scup are demersal fish that primarily occur primarily along the United States coast from Massachusetts to South Carolina, and have been observed as far north as the Bay of Fundy

(Steimle et al. 1999). Scup occur within the Delaware estuary in spring and summer (NMFS 2014b). Inland habitat for scup includes sand, mud, mussel, and eelgrass bed type substrates (NFMS 2014b).

Juveniles prey on small crustaceans, such as amphipods, polychaetes, and copepods (Steimle et al. 1999). In the Hudson-Raritan Estuary, Steimle et al. (2000) examined stomachs of 254 juvenile scup. Steimle et al. (2000) recorded 39 prey items or taxa, including 8 polychaetes, 7 amphipods, 6 decapod crustaceans, 6 mollusks, 2 mysids, and other taxa (e.g., hydroids). Steimle et al. (1999) and (2000) reviewed various feeding studies of scup and did not note any studies where scup consumed *Alosa* spp.

Winter flounder (*Pleuronectes americanus*): Adult and Juvenile

<u>Designated EFH</u>

EFH for winter flounder has not been designated in the Schuylkill River, Perkiomen Creek, or the portion of the Delaware River in which Point Pleasant Pumping Station is located. Designated EHF for adult and juvenile winter flounder includes the mixing zone of the Delaware River (NMFS 2014a).

<u>Species Description and Diet</u>

There are three stocks of winter flounder in the Atlantic—the Gulf of Maine, southern New England and the Middle Atlantic, and Georges Bank (Pereira et al. 1999). In the Delaware Bay, juvenile winter flounder tend to occur within bottom habitats with a substrate of mud or fine grained sand while adults occur within bottom habitats including estuaries with substrate of mud, sand, gravel (NMFS 2014b). Adult winter flounder are a small-mouthed, right-eyed flounder that grow to 23 in. (58 cm) in total length and live up to 15 years (Pereira et al. 1999).

Winter flounder consume a wide variety of prey. Adults and juveniles feed on benthic invertebrates such as polychaetes, cnidarians, mollusks, amphipods, and hydrozoans (Pereira et al. 1999). A few studies have documented that winter flounder may occasionally feed on fish. Pereira et al. (1999) and Steimle et al. (2000) reviewed various feeding studies of winter flounder and did not note any studies where winter flounder consumed *Alosa* spp.

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